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## ASSESSMENT OF SEISMICITY IN AZERBAIJAN AND ADJACENT REGIONS IN 2022 BASED ON DATA FROM "KINEMATICS" SEISMIC STATIONS

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### ABSTRACT

In 2022, seismicity analysis was conducted based on 62 digital seismic stations. Throughout the year, 12,284 earthquakes were recorded. Of these, 3,383 were local earthquakes (occurring in the territory of Azerbaijan), 3,314 were regional, and 4,011 were distant earthquakes. Additionally, 1,463 weak tremors (registered by a single station) and 1,575 industrial explosions were recorded. Compared to 2021, the number of earthquakes in 2022 and the amount of released seismic energy decreased. In 2021, there were 6,071 earthquakes: the amount of seismic energy released was  $\sum E = 6.02 \times 10^{12}$  J, with a maximum magnitude of  $m_l = 5.1$ . In 2022, the amount of released seismic energy was  $\sum E = 8.55 \times 10^{11}$  J, with a maximum magnitude of  $m_l = 4.9$ . Throughout 2022, seismicity was observed in the Greater Caucasus, the Middle Kura Basin, and the Caspian Sea. Seismic activation was noted in the West Caspian, Palmira-Absheron, Aji-Chay-Alat, Ganja-Chay-Alazan, Gazakh-Signakh, Talysh, Akhvai, Sangachal-Ogurjuq, Garabogaz-Safidrud, and Agrahan-Kasnowod regions. Another mud volcano eruption occurred in Lokbatan, and based on the arrival time of waves from the stations, the period of mud volcano eruption activation, the depth of the focus, the duration of the eruption, and the energy released during the eruption were determined. The mechanisms of 48 earthquake foci were identified. Analysis of compression and extension axes, based on data from earthquake focus mechanisms, showed that the central and western parts of the republic's territory are mainly characterized by compressive stress. Tensile stress is observed in the Gobustan-Absheron region, the central parts of the Caspian Sea, and the Guba-Gusar regions.

**Keywords:** seismic analysis, West Caspian fault, Palmira-Absheron, Aji-Chay-Alat tectonic faults, earthquake focus mechanism analysis, mud volcano.

## “KINEMETRIKS” SEYSMIK STANSİYALARININ MƏLUMATLARI ƏSASINDA 2022-Cİ İLDƏ AZƏRBAYCAN VƏ ƏTRAF BÖLGƏLƏRİN SEYSMIKLIYININ QIYMƏTLƏNDİRİLMƏSİ

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### XÜLASƏ

2022-ci ildə 62 rəqəmsal seysmik stansiya əsasında seysmiklik təhlili aparılmışdır. İlin ərzində 12 284 zəlzələ qeydə alınmışdır. Onlardan 3383-ü yerli zəlzələ (Azərbaycan ərazisində baş verən), 3314-ü regional

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və 4011-i uzaq zəlzələlərdir. Bundan əlavə, 1463 zəif təkan (yalnız bir stansiya tərəfindən qeydə alınan) və 1575 sənaye partlayışı qeydə alınmışdır. 2021-ci illə müqayisədə 2022-ci ildə zəlzələlərin sayı və ayrılan seysmik enerji miqdarı azalmışdır. Belə ki, 2021-ci ildə 6071 zəlzələ baş vermişdir: ayrılan seysmik enerjinin miqdarı  $\sum E = 6.02 \times 10^{12}$  C, maksimum maqnitud  $m_l = 5.1$  olmuşdur. 2022-ci ildə ayrılan seysmik enerji miqdarı  $\sum E = 8.55 \times 10^{11}$  C olmuş, maksimum maqnitud  $m_l = 4.9$  olmuşdur. 2022-ci il ərzində seysmiklik Böyük Qafqazda, Orta Kür hövzəsində və Xəzər dənizində müşahidə edilmişdir. Seysmik aktivləşmə Qərbi-Xəzər, Palmir-Abşeron, Aciçay-Alat, Gəncəçay-Alazan, Qazax-Siqnağ, Taliş, Axvay, Sanqaçal-Oğurcuq, Qaraboğaz-Səfidrud, Aqraxan-Krasnovod zonalarında müşahidə edilmişdir. Lökbatanda növbəti palçıq vulkanı püskürmüş, stansiyalardan gələn dalğaların gəlmə vaxtı əsasında palçıq vulkanlarının püskürmə dövrü, ocağın dərinliyi, püskürmənin davamlılığı və püskürmə zamanı ayrılan enerji müəyyən edilmişdir.

48 zəlzələnin ocaq mexanizmləri müəyyən edilmişdir. Zəlzələ ocaq mexanizmlərinin məlumatları əsasında sıxılma və gərilmə oxlarının analizi göstərmişdir ki, respublikanın mərkəzi və qərb hissələri əsasən sıxılma gərginliyi ilə xarakterizə olunur. Gərilmə gərginliyi Qobustan-Abşeron ərazisində, Xəzərin mərkəzi hissələrində və Quba-Qusar bölgələrində müşahidə olunur.

**Açar sözlər:** seysmik təhlil, Qərbi-Xəzər qırığı, Palmir-Abşeron, Aciçay-Alət tektonik qırılma zonaları, zəlzələ ocağı mexanizmlərinin təhlili, palçıq vulkanı.

## ОЦЕНКА СЕЙСМИЧНОСТИ АЗЕРБАЙДЖАНА И ПРИЛЕГАЮЩИХ РЕГИОНОВ В 2022 ГОДУ НА ОСНОВЕ ДАННЫХ СЕЙСМИЧЕСКИХ СТАНЦИЙ “KINEMATRICS”

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### АННОТАЦИЯ

В 2022 году был проведен анализ сейсмичности на основе 62 цифровых сейсмических станций. В течение года было зарегистрировано 12284 землетрясений. Из них 3383 местных землетрясений (произошедших на территории Азербайджана), 3314 региональных и 4011 отдаленных землетрясений. Кроме этого, было зафиксировано 1463 слабых толчка (зафиксированных одной станцией) и 1575 промышленных взрывов. По сравнению с 2021 годом количество землетрясений в 2022 году и количество выделяемой сейсмической энергии уменьшились. Так, в 2021 г. произошло 6071 землетрясений: количество выделившейся сейсмической энергии  $\sum E = 6.02 \cdot 10^{12}$  Дж, максимальная магнитуда  $m_l = 5.1$ . В 2022 г. количество выделившейся сейсмической энергии составило  $\sum E = 8.55 \cdot 10^{11}$  Дж, максимальная магнитуда  $m_l = 4.9$ . В течение 2022 года сейсмичность наблюдалась на Большом Кавказе, в бассейне Средней Куры и Каспийском море. Сейсмическая активизация наблюдается по Западно-Каспийскому, Пальмирско-Апишеронскому, Аджичай-Алатскому, Гянджачай-Алазанскому, Газахско-Сигнахскому, Тальишскому, Ахвайскому, Сангачал-Огурджускому, Гарабогаз-Сафидрудскому, Аграханско-Каснаводскому. В Локбатане произошло очередное извержение грязевого вулкана, и на основе времени прихода волн от станций были определены период активизации извержения грязевых вулканов, глубина очага, продолжительность извержения и энергия, высвобожденная во время извержения.

*Были определены механизмы очагов 48 землетрясений. Анализ осей сжатия и растяжения, выполненный на основе данных о механизмах очагов землетрясений, показал, что центральная и западная части территории республики в основном характеризуются сжимающим напряжением. Напряжение растяжения наблюдается в районах Гобустан-Абшерон и в центральных частях Каспия, а также в районах Губа-Гусар.*

**Ключевые слова:** сейсмический анализ, Западно-Каспийский разлом, Пальмиро-Абшеронский, Аджидай-Алатский тектонические разломы, анализ механизмов очагов землетрясений, грязевой вулкан.

### **Introduction**

In the article, the seismic activity of Azerbaijan and neighboring regions in 2022 is analyzed within the framework of 38.0–42.0° north latitudes and 44.5–52.0° east longitudes. The high seismicity of this region is mainly related to large tectonic structures such as the south-east sinking of the Greater Caucasus, the Kura depression, the northeastern slope of the Lesser Caucasus, Talysh and the Caspian Sea water area. As in previous years, seismic monitoring in the mentioned region was carried out by the Republican Seismological Service Center of the Azerbaijan National Academy of Sciences. In 2021, the seismic station network of RSXM ANAS consisted of 35 digital stations and also included data from three Georgian stations (BGD, DDFL, VSHL) and two Turkish stations (IGD, Hakkart). The technical equipment of stations of RSXM ANAS is described in detail in the article [3]. [2] in the article, earthquakes with a magnitude of  $m_l=3.0$  and greater are recorded in a wide area of the republic, including in the areas of the shelf zone of the Caspian Sea. In the remaining water area of the Caspian Sea and in the territories of neighboring countries, it is possible to register shocks with  $m_l>3.0$ .

### **Processing Methodology**

The methods of determining the main characteristics of earthquakes have remained the same. Antelope Real-Time System, version 5.6, dbloc2 software was used for the localization of earthquakes, and the average velocity model of the deep geological structure of Azerbaijan was applied [7, 9]. In the article, two approaches were used for the calculation of focal mechanisms: the analysis of the first signs of P-waves and the wave inversion method. Time-Domain Moment Tensor INverseCode (TDMT INVC) algorithm was used for waveform inversion [4, 5]. The main seismogram source was the Republic Seismological Service Center, from where the data was downloaded in MiniSEED format and converted to SAC format. Broadband seismograms were selected according to distance (70–350 km) and had to be of sufficient length (interval from P-waves to S-waves) and quality (high signal-to-noise ratio and no clipping). Preparation of seismograms for inversion consisted of several stages: removal of the input part of P-wave, deconvolution (restoration of real ground displacements), determination of epicentral distance, straight and reverse azimuths, calculation of radial and transverse components and filtering. Deconvolution was performed in the time domain, and a 4th-order Butterworth filter was used for the bandpass filter.

### **Analysis of seismicity**

During 2022, 62 seismicity analyzes were conducted based on digital data. During that year, 12,284 earthquakes were recorded. 3383 of them are local (territory of Azerbaijan), 3314 are regional and 4011 are remote earthquakes [10]. In addition, 1575 explosions and 1 volcano were recorded. A map of the epicenters of the earthquakes that occurred in the territory of Azerbaijan was drawn up (Figure 1).

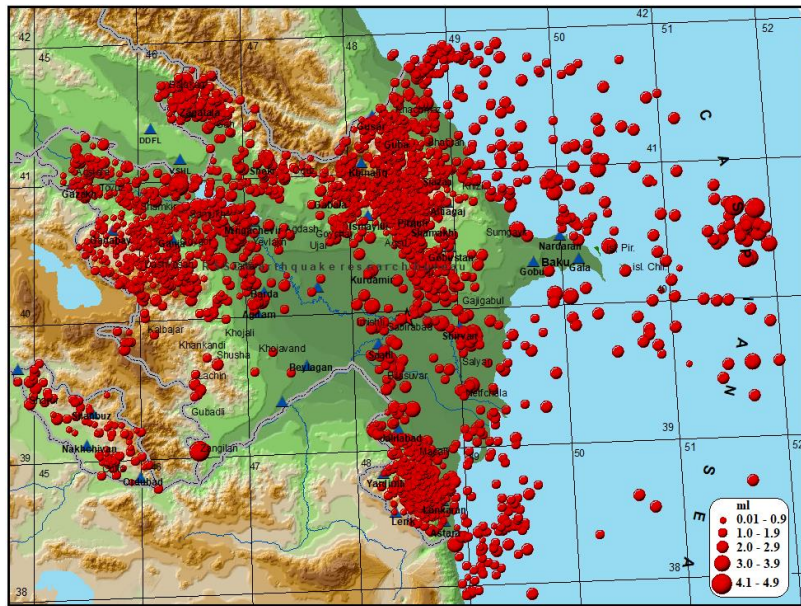


Figure 1. Map of epicenters of earthquakes that occurred in Azerbaijan

In 2022, 52 earthquakes with magnitude  $m_l \geq 3$  were recorded in the territory of Azerbaijan. 19 perceptible earthquakes were recorded in Azerbaijan and adjacent areas. A map of epicenters of earthquakes with magnitude  $m_l \geq 3$  and felt was constructed (Figure 2).

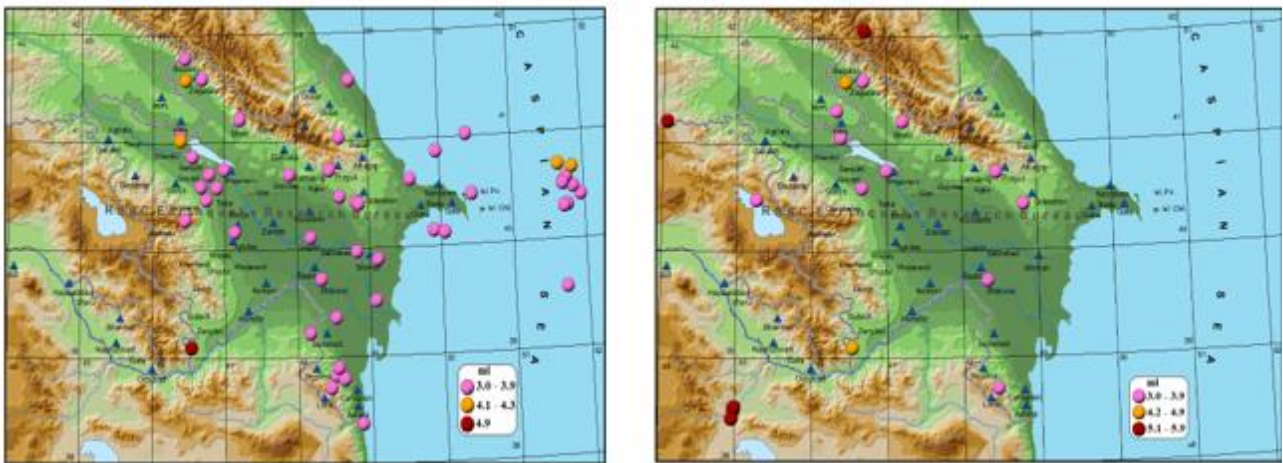


Figure 2. Map of epicenters of earthquakes with a magnitude  $m_l \geq 3$  in the territory of Azerbaijan and felt in Azerbaijan and adjacent territories during 2022

The analysis of the number of earthquakes that occurred in Azerbaijan and the distribution of the released seismic energy by month (Figure 3.) shows that the released seismic energy was higher in January than in other months. This is related to the strong magnitude  $m_l=4.9$  earthquake that occurred in Zangilan region. In May, the number of earthquakes was higher than in other months.

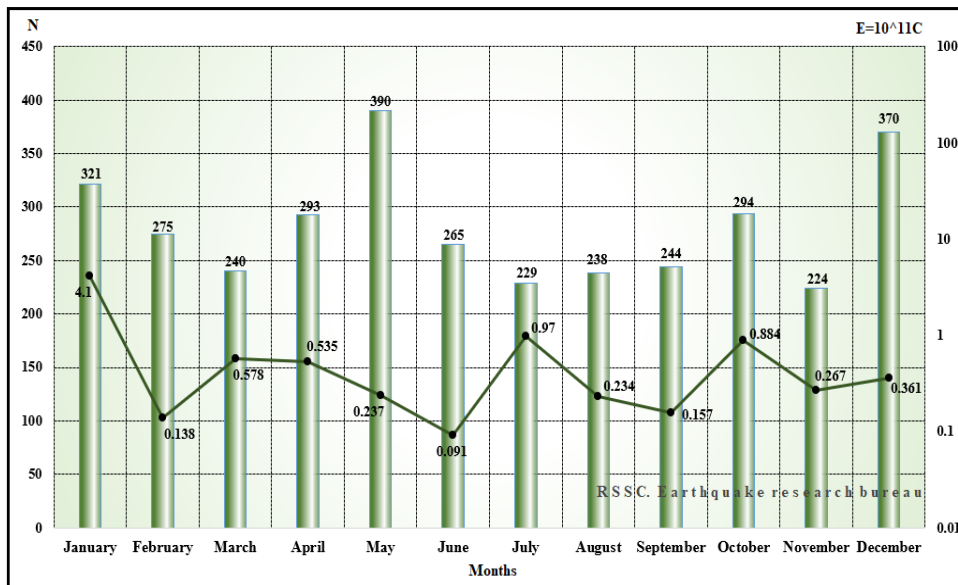


Figure 3. Distribution of the number of earthquakes in Azerbaijan and the released seismic energy by month

An activity map of 2022 was drawn up and analyzed to monitor the change of the seismic regime over time (Fig. 4). In 2022, high seismic activity is observed in some areas, while other areas are characterized by low seismicity.

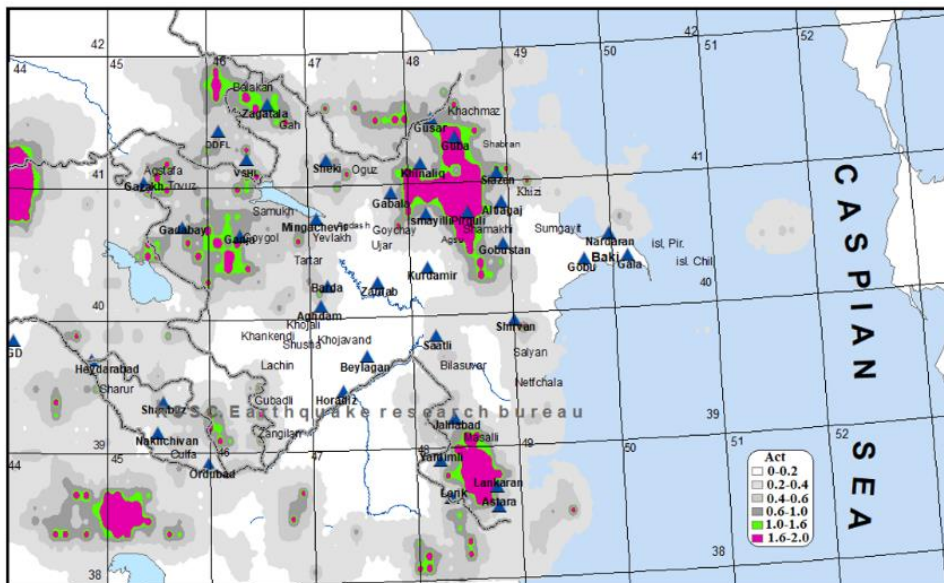


Figure 4 Activity map of Azerbaijan and adjacent territories in 2022

As can be seen from the map, activity was high in Shamakhi-Ismayilli ( $A_{10}=1.7-2.0$ ), Gusar-Guba, ( $A_{10}=1.5-1.7$ ), Talish ( $A_{10}=1.6-2.0$ ) zones. Zagatala-Balaken, Azerbaijan-Georgia border on the southeastern slope of the Greater Caucasus is characterized by values ( $A_{10}=1.3-1.8$ ). In 2022, an increase in seismicity was recorded in the Small Caucasus, Middle Kur (Kazakh-Aghstafa, Samukh area ( $A_{10}=1.0-1.6$ )). In addition, in the north and center of the Caspian ( $A_{10}=0.4-0.6$ ), in the south of the Caspian ( $A_{10}=1.0-1.6$ ) increased seismicity was recorded on the Georgia-Armenia border ( $A_{10}=1.6-2.0$ ).

**Greater Caucasus area.** A seismological fault has been established along the Balaken-Gabala II profile passing through the seismoactive zone of Azerbaijan (Figure 5.). The profile extends along the Ayrichay-Aletsh deep fault in the pan-Caucasus direction. The density of earthquakes is observed in the Zagatala-Balakan area in

the north-west direction of the intersection. 2 earthquakes with magnitude  $m_l \leq 4.2$  were registered in Zagatala territory. On April 15, at 17:02 local time, an earthquake with a magnitude of  $m_l=3.9$  was recorded in the Zagatala area, 7 km southeast of the Zagatala station. The earthquake was felt up to 4 in the epicenter and 3 in nearby residential areas. An imperceptible earthquake with a magnitude of 3.2 was recorded in the Balaken area. In the north-west direction of the fault, earthquakes are mainly distributed at a depth of 3-23 km. The shock with magnitude  $m_l=4.2$  occurred within 9 km of the subsidence layer, earthquakes with  $m_l \leq 3.9$  occurred at a depth of 18 km. The earthquake foci are located in the impact zone of the Alazan-Eyrichay fault.

An increase in seismicity is observed in the Sheki-Gabala plains. Against the background of weak seismicity, an earthquake with a magnitude of  $m_l=3.0$  was recorded in Sheki region. The earthquake was felt up to 3 points in the epicenter. The earthquake occurred within a 7 km depth subsidence layer. The epicenters of the earthquake are located in the impact zone of the Alazan-Eyrichay fault. In the Sheki-Gabala plains, earthquakes are mainly spread at a depth of 2-30 km. Earthquakes with depths of up to 40 km were recorded in these areas. Seismicity in Shamakhi-Ismayilli zone in 2022 compared to 2021 was higher than the background level. When moving to the Shamakhi-Ismayilli zone, one observes the migration of the hearths in the NE and NE direction. The northern part of the Shamakhi-Ismayilli zone is more active. A density of hypocenters is observed at a depth of 4-12 km up to the Dashgil-Mudrasa and Alazan-Ayrichay-Alat faults. Here, reflective boundaries are located at a depth of 10-12 km. Earthquakes with magnitude  $m_l \leq 1.9$  were distributed at a depth of 10 km.

On September 1, at 22:21 local time, an earthquake with a magnitude of  $m_l=3.4$  was recorded in Agsu district, 10 km southwest of Pirgulu station. The earthquake was felt up to 3 points. As can be seen from the section, earthquakes with great depths also occur in Shamakhi-Ismayilli area. In the Ismayilli district, an earthquake with an imperceptible magnitude of  $m_l=3.0$  occurred at a depth of 44 km. 2 earthquakes with magnitude  $m_l \geq 3.0$  were recorded in Gobustan territory. On October 29, at 17:50 local time, an earthquake with a magnitude of  $m_l=3.6$  was registered in Gobustan region, 42 km south of Pirgulu station. The earthquake was felt up to 3 points. After the earthquake, an imperceptible earthquake with a magnitude of  $m_l=3.1$  was recorded on October 30. The earthquakes occurred within the 4 km deep subsidence layer.

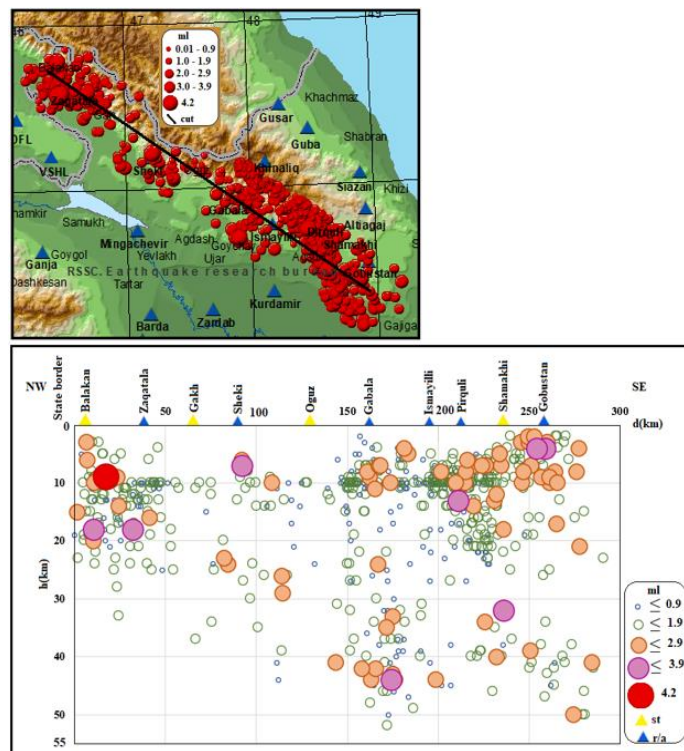


Figure 5. Seismological cross-section at depth in the NW-SW direction in the Greater Caucasus

**The territory of the Lesser Caucasus.** In order to study the seismicity of the Karabakh territory in 2022, a map of epicenters of explosions and earthquakes was created (Figure 6). In contrast to 2021, a decrease in the number of explosions due to road construction in the territory of Karabakh is observed. Industrial explosions were registered in Kalbajar area in 2022 as it happens every year. This leads to an increase in the seismic activity of the area.

The reason for the increase in the number of explosions in the territory of Karabakh is the construction of roads. In connection with the construction of roads, mountains and tunnels are blown up in the areas. I would like to mention that the waveform of road construction explosions differs from that of industrial explosions. Activation is observed in Agdam and Zangilan areas in 2022. On January 16, at 07:25 local time, an earthquake with a magnitude of  $m_l=4.9$  was recorded in Zangilan district, 53 km northeast of Ordubad station. The earthquake was felt up to 5 in the epicenter and 4-3 in the surrounding regions. 1 foreshock and 7 aftershocks were recorded before the mainshock. A spatial distribution map of the seismic intensity of the earthquake that occurred in Zangilan region was drawn up based on the ELER program (Figure 6).

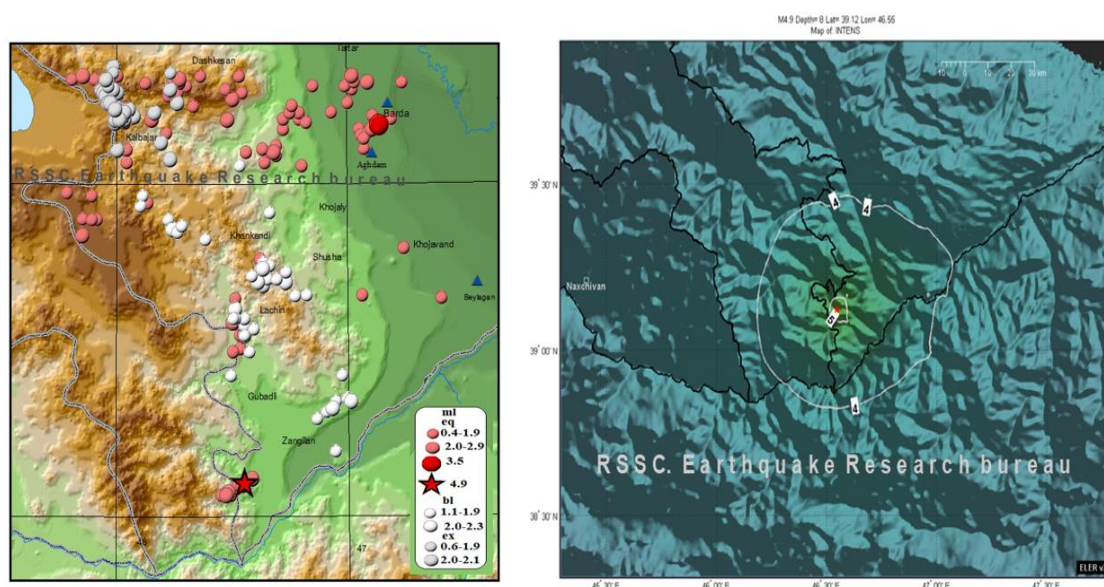


Figure 6. Map of epicenters of earthquakes in the territory of Karabakh and spatial distribution map of seismic intensity

On October 4, at 05:41 local time, an earthquake of magnitude  $m_l=3.5$  was recorded in Agdam region, 9 km southwest of Barda station. The earthquake was not felt.

**Caspian water area.** In 2022, compared to 2021, the seismicity of the Caspian Sea was lower than the background level. The analysis of the distribution of the number of earthquakes and the released seismic energy shows that the number of earthquakes and the released seismic energy have decreased. The occurrence of earthquakes with magnitude  $m_l \leq 4.2$  in the Central Caspian water area is related to the activation of the Makhachkala-Krasnovodsk fault. The concentration of earthquakes in the center is observed at the intersection of the Agrakhan-Krasnovodsk and transverse Karabogaz Safidrud faults. The foci are spread at a depth of 3-62 km. Towards the center, the increase of earthquakes with magnitude  $m_l \geq 3$  is registered. Earthquakes with magnitude  $m_l \geq 3$  are observed to be distributed at a depth of 23-62 km. The highest earthquake magnitude in the Caspian water area was  $m_l=4.3$ . The earthquake occurred at a depth of 62 km.

**Erupting mud volcano.** The Lokbatan mud volcano is one of the world-famous volcanoes located on the Absheron Peninsula of Azerbaijan, near the Lokbatan settlement. This volcano is recognized in both local and international scientific circles as an important natural phenomenon for researchers interested in mud volcanism. The Lokbatan mud volcano first erupted in 1810 and has been active many times since then. During volcanic eruptions, mud, oil, gas and water come to the surface and cover large areas. In 2001, a large mudflow

occurred during the activity of the Lokbatan volcano, and this event attracted the attention of local and international media [1, 6]. On 11.08.2022 at 09:36 local time, another eruption of the mud volcano was observed in Lokbatan. Based on the arrival times of the waves from the stations for the event, the activation period of the eruption of mud volcanoes, the depth of the crater, the continuity of the eruption and the energy released during the eruption were determined.

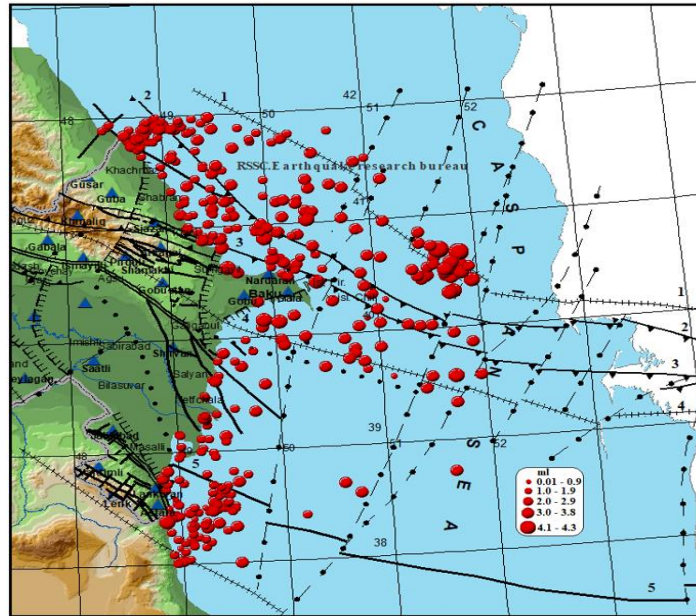


Figure 7. Earthquakes ruptures and epicenters map that occurred in the Caspian water area during 2022. Fractures: 1- Agrakhan-Krasnavodsk; 2 – Makhachkala-Krasnavodsk; 3- Absheron-Pribalkhan; 4 – Sangachal-Ogurchu; 5- Mil-Khishishlar 6 - Garabogaz-Safidrud; 7 – Laxiridjan [11, 13]

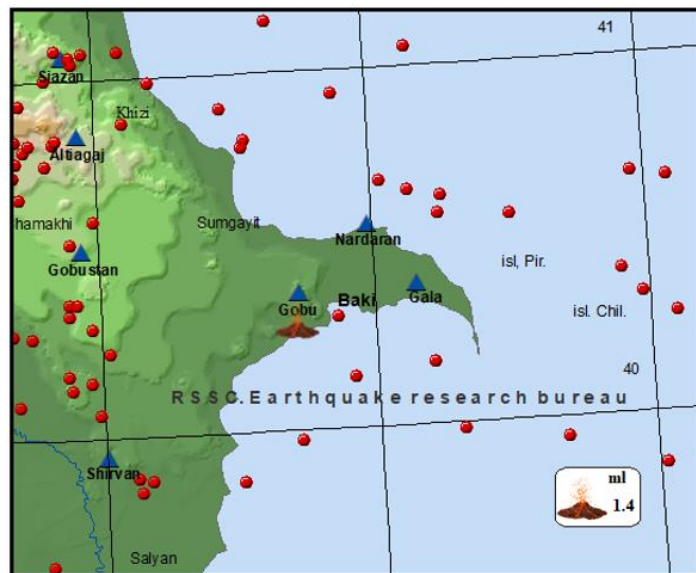


Figure 8. Map of epicenters of earthquakes and volcanoes that occurred on 01.05.2022-11.08.2022 Based on the arrival time of the waves from the stations of the volcano, the activation period of the mud volcano eruption is 05:36, the depth is h-3, and the duration of the eruption is 5 minutes. 12 sec., the seismic energy released during the eruption was determined to be  $E=0.6 \cdot 10^7$ .



№	Date	Time UTC	Coordination		h, Δ km	ml	Duration
			φ	λ			
1	11.08.2022	05:36:47.06	40.30	49.71	3	1.4	5 m.12h

The volcano was recorded by telemetric seismic stations at Gobu, Nardaran, Gala, Gobustan, Shirvan, Gusar stations.

### Mechanisms of earthquake foci.

In 2022, an analysis of the focal mechanisms of 9 earthquakes in the territory of the Greater Caucasus was carried out (Fig. 9) [8]. On March 1 at 14:34:34 local time, an earthquake with magnitude  $m_l=4.2$  and depth  $H=9$  km was recorded in Zagatala region. The directions of both compression (P) and tension (T) axes of the earthquake are oriented in the plane close to the horizon ( $PL=9-28$ ). A sharp angle of incidence ( $DP=77-64$ ) was determined for both nodal planes. Displacement values at the hearth show that left-lateral displacement is dominantly uplift-type movement, and is consistent with the Kakheta transverse fault. It should be noted that On April 15 at 17:02:35 local time, another earthquake was registered in Zagatala region (magnitude  $m_l=3.9$  and depth  $H=23$  km). The direction of the compressive (P) stress axes of the earthquake are oriented in the plane close to the horizon ( $PL=8$ ). A sharp angle of incidence ( $DP=57-41$ ) was determined for both nodal planes. The value of the displacement in the hearth shows that the fault-uplift type of movement is dominant, and is consistent with the longitudinal Shambul-Ismaili fault.

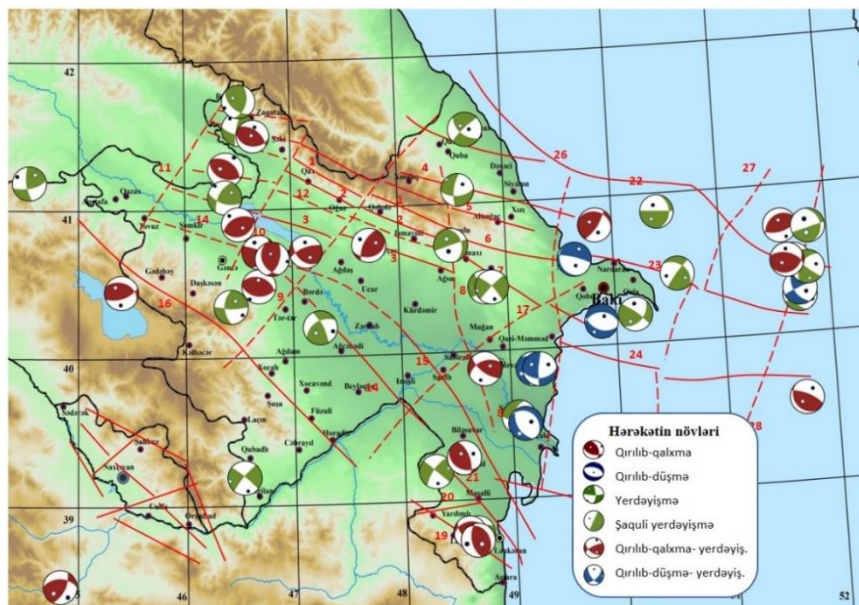


Figure 9. Focal mechanisms of earthquakes with  $m_l \geq 3.0$  that occurred in the first half of 2022  
(Map of ruptures was compiled by:[12-13])

Ruptures: 1-Dashgil-Madrassa, 2-Vendam, 3 - Gokchay, 4-Siyazan, 5-Zangi-Kozluchay, 6-Germian, 7-Acichay-Alat, 8-Western-Caspian, 9-Arpu-Samur, 10-Ganjachay-Alazan, 11-Kazakh-Signakh, 12-Northern -Acinour, 13-Iori, 14-Kur, 15-Mingachevir-Saatli, 16-Bashlibel, 17-Palmir-Apsheron, 18-Akhti-Nügedi-Kiliziali, 19-Talish, 20-Yardimli, 21-Öntalish, 22-Center - Khazar, 23 - Apsheron-Pribalkhan, 24 - Sangachal-Ogurchi, 25 - Chikishes, 26 - Yashma flexure, 26a - Gyzilagac, 27 - Shakhov-Azizbeyov, 28 - Garabogaz-Safidra

On July 23, at 12:09:11 local time, an earthquake with a magnitude of  $m_l=3.1$  and a depth of  $H=7$  km was registered in Balakan region. The direction of the compression axis (P) of the earthquake is horizontal ( $PL=0$ ), and the direction of the tension stress axis (T) is oriented in the plane close to vertical ( $PL=53$ ). A sharp angle of incidence ( $DP=56-56$ ) was determined for both nodal planes. The value of the displacement in the furnace shows that the fault-uplift-displacement type of movement prevails, and it is consistent with the Vandam Sharur-zakatala faults.

In 2020, the increase in seismicity, which began at the collision of the Shamakhi and Hajigabul seismogenic zones, continues in 2022. On February 7, at 17:56:11 local time, an earthquake with a magnitude of  $m_l=3.4$  and a depth of  $H=6$  km was recorded in Hajigabul region. The value of the displacement in the furnace indicates the predominance of fault-uplift type movement and is consistent with the Kura fault.

The strongest earthquake of the year occurred on January 16 at 07:25:04 local time in Zangilan region (magnitude  $m_l=4.9$  and depth  $H=6$  km) was registered. Both compression (P) and tension (T) axes of the earthquake are oriented in the plane close to the horizon ( $PL=8-1$ ). A sharp dip angle ( $DP=85-83$ ) has been determined for both nodal planes, and the value of the displacement in the focus indicates that the movement of the left side displacement type prevails [8].

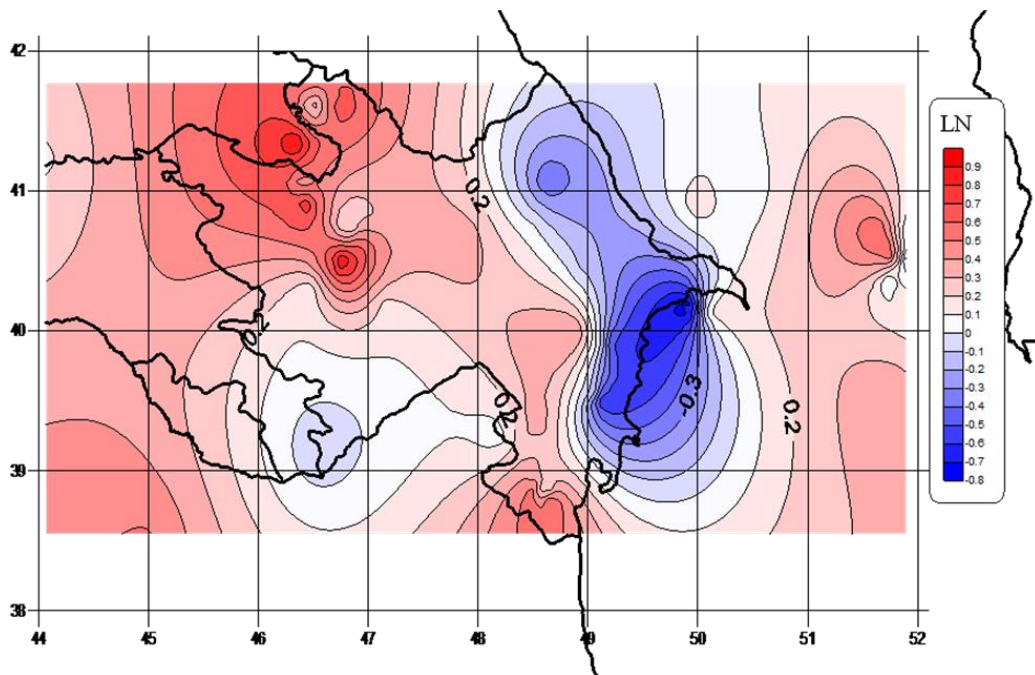


Figure 10. Distribution map of the Lode-Nadai coefficient calculated on the basis of the mechanisms of the earthquakes that occurred in 2022

On March 9, at 22:24:54 local time, an earthquake with a magnitude of  $m_l=3.0$  and a depth of  $H=13$  km was recorded in Goranboy region. After that earthquake, another earthquake with a depth of  $H=17$  km was recorded at 22:22:22 local time on April 28. Earthquakes occurred as a result of compressional stress. Displacement values at the hearth indicate a dominant fault-uplift type movement, and are consistent with the Jamubi Kura fault. On October 28 at 11:09:16 local time, another earthquake with magnitude  $m_l=3.0$  and depth  $H=10$  km was recorded in Goranboy region. Both compression (P) and tension (T) axes of the earthquake are oriented in the plane close to the horizon ( $PL=11-23$ ). A sharp angle of incidence ( $DP=82-66$ ) was determined for both nodal planes. The value of the displacement in the furnace shows that the movement of the left-side displacement type prevails, and is compatible with the Arpa-Samur fault.

On July 31 at 18:35:12 local time, the magnitude  $m_l=3.3$  and the depth  $H=10$  km in Jalilabad region. Both the compression (P) and tension (T) axes of the earthquake were oriented in the plane close to the horizon ( $PL=11-15$ ) and right-lateral displacement-type movements were determined in the center and were consistent

with the Burovar fault. However, on September 6, at 08:05:52 local time, another earthquake with magnitude  $m_l=3.0$  and depth  $H=41$  km was recorded in Jalilabad region. A flat incidence angle ( $DP=24$ ) was determined for the second nodal plane of the earthquake. The value of the displacement in the hearth shows that the overthrust-type movement is dominant, and is consistent with the Bilasuvar fault.

In addition, it should be noted that several strong earthquakes with magnitude  $m_l=5.5-5.7$  and depth  $H=15-28$  km were recorded on the territory of Iran from September 21 to October 5. The value of the displacement in the crater shows that the fault-uplift type of left-lateral displacement type of movement prevails, and is consistent with the Başkale Khoy and Tabriz faults.

The Caspian Sea water area in 2022 is characterized by high seismicity, as in previous years. The mechanism of a total of 14 earthquakes with magnitude  $m_l \geq 3.0$  in 2022 in the Caspian Sea region was worked out. The analysis showed that the earthquakes occurred mainly in the intersection zones of the Agrakhan-Krasnovodsk, Sangachal-Ogurchu (Krasnopolyansk), Shakhovo-Azizbeyov and Garabogaz-Safidrud faults.

Thus, as a result of the orientation of the compression and tension axes, a distribution map of the Lode-Nadai coefficient was constructed. As can be seen from the picture, the central, southern and western part of the territory of the republic is mainly characterized by compressive stress. Tensile stress is observed in the Gobustan-Absheron area and the middle parts of the Caspian Sea, and in the Guba-Gusar region (Fig. 10).

### Conclusion

During 2022, 62 seismicity analyzes were conducted based on digital data. 12,284 earthquakes were recorded during the year. Of them, 19 perceptible earthquakes were recorded. In the territory of Azerbaijan, the strongest earthquake with a magnitude of  $m_l=4.9$  occurred in the Zangilan area.

In 2022, the explosions that occurred during road construction in the Karabakh area decreased, and activation was observed in the Agdam and Zangilan areas in 2022. Activity was high in Shamakhi-Ismayilli, Gusar-Guba, Gabala-Khinalig and Talish zones. On the southeastern slope of the Greater Caucasus, Zagatala-Balakane ( $A_{10}=1.0-1.6$ ), Small Caucasus, Gazakh-Aghstafa ( $A_{10}=1.0-1.6$ ) values are characterized. In 2022, an increase in seismicity was recorded in the Samukh area. At the same time, weak seismicity is observed in the Caspian Sea. Seismicity was high on the Georgia-Armenia border ( $A_{10}=1.6-2.0$ ). An increase in activity compared to 2021 ( $A_{10}=1.6-2.0$ ) is observed in the Iranian region

On 11.08.2022 at 09:36 local time, a mud volcano erupted in Lokbatan, and based on the arrival times of the waves from the stations for the event, the activation period of the mud volcano eruption, the depth of the crater, the duration of the eruption, and the energy released during the eruption were determined.

2022 An increase in seismicity is observed in Göranboy and Neftchala regions. Two earthquakes with magnitude  $m_l=3.0$  were recorded in Neftchala region on January 14 at 17:45:36 local time and on April 20 at 20:09:08 local time. Earthquakes occurred as a result of tensile stress. The value of the displacement in the furnace shows that the fault-fall type of movement prevails, and it is compatible with the Pirsaat-Salyan-Neftchala fault.

On March 09 at 22:24:54 local time, an earthquake with a magnitude of  $m_l=3.0$  was recorded in Goranboy region. After that earthquake, another earthquake was registered on April 28 at 22:22:22 local time. Earthquakes occurred as a result of compressional stress. The value of the displacement in the hearth indicates a dominant fault-uplift type of movement, and is consistent with Kura faulting. The mechanism of 14 earthquakes with magnitude  $m_l \geq 3.0$  in 2022 in the Caspian water area has been worked out. The analysis showed that the earthquakes occurred mainly in the intersection zones of the Agrakhan-Krasnovodsk, Sangachal-Ogurchu (Krasnopolyansk), Shakhovo-Azizbeyov and Garabogaz-Safidrud faults. The values of the displacement in the hearth show that the movements of the broken and falling type prevail.

The analysis of compression and tension axes based on the data of the earthquake source mechanisms showed that the central and western part of the territory of the republic is mainly characterized by compression stress. Tension is observed in the Gobustan-Absheron area and the middle parts of the Caspian Sea, and in the Guba-Gusar region.

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